SCREENING OF PREGNANT WOMEN AGED 40 YEARS OLD AND ABOVE FOR CARDIAC ABNORMALITIES USING ELECTROCARDIOGRAPHY (ECG) TO PREVENT MATERNAL MORTALITY

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DISCLAIMER

Technology review is a brief report, prepared on an urgent basis, which draws on restricted reviews from analysis of pertinent literature, on expert opinion and / or regulatory status where appropriate. It has been subjected to an external review process. While effort has been made to do so, this document may not fully reflect all scientific research available. Additionally, other relevant scientific findings may have been reported since completion of this review.

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DISCLOSURE

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EXECUTIVE SUMMARY

Introduction

Globally, approximately 210 million women become pregnant and some 130 million give birth. Although most of this pregnancy is uneventful, an estimated 15% develop complications, and about one third of these have life threatening consequences. Complication related to pregnancy and childbirth result in more than half a million death and 99% of them occur in developing country.
Maternal heart disease complicates at least 1% of pregnancies and is one of the most important causes of maternal death. Recognizing heart disease during pregnancy is challenging because the physiological changes during pregnancy can cause symptoms and signs mimicking cardiac disease. Obstetric caregivers must be able to distinguish signs and symptoms attributable to normal pregnancy from cardiac pathology. Electrocardiography (ECG) and echocardiogram is the first-choice investigations that need to be performed when pathology is suspected.

This technology review was conducted following a request from Director of Family Health Development, Ministry of Health (MOH) Malaysia about the effectiveness, cost effectiveness, safety and other aspect regarding screening of pregnant women aged 40 yearS old and above for cardiac abnormalities using ECG to prevent maternal mortality.

Objective/aim

The objective of this technology review was to review evidence on the effectiveness, cost-effectiveness and safety on the use of ECG to screen cardiac abnormalities in pregnant women age 40 years old and above to prevent maternal mortality.

Results and conclusions

There was no retrievable scientific evidence on the safety and cost-effectiveness on the use of ECG to screen cardiac abnormalities in pregnant women aged 40 years old and above.

There was one cross-sectional study conducted by Akinwusi et al. among healthy pregnant Nigerian women and non-pregnant women. The author reported cardiovascular and electrocardiographic changes found in these healthy pregnant Nigerian women. The study showed that, there were some distinctive ECG features which may help to differentiate cardiac disease in pregnancy from normal cardiac findings in our practice area. However, this is considered as fair level evidence which warrants high quality clinical research.

Methods

Literatures were searched through electronic databases specifically PubMed, Medline, Cochrane, Ovid, Horizon scanning databases and from non scientific database - Google search engine. In addition, a cross-referencing of the articles retrieved was also carried out accordingly to the topic. Relevant articles were critically appraised and evidence graded using US/Canadian Preventive Services Task Force.

SCREENING OF PREGNANT WOMEN AGED 40 YEAR OLD AND ABOVE FOR CARDIAC ABNORMALITIES USING ELECTROCARDIOGRAPHY (ECG) TO PREVENT MATERNAL MORTALITY

1. INTRODUCTION

Maternal mortality is defined by the World Health Organization (WHO) as the death of a woman while pregnant or within 42 days of the termination of pregnancy irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.[1] It is estimated that there are about 529,000 maternal deaths worldwide with an average maternal mortality ratio of 400 per 100,000 live births, and majority (99%) of these deaths occur in developing countries and the vast majority of these deaths are preventable.[1]Malaysia had done well in reducing the number of maternal death over the years. The maternal mortality ratio declined from 530 per 100,000 live births in 1957 to 148 per 100,000 in 1970 and 30 per 100,000 live births in 2000. Further drop was seen in 2008, it was reported as 28.9 per 100,000 live births. However, the number seemed to be static with difficulty in achieving the mortality ratio of 11 deaths per 100,000 live births by 2015.[2]

There are three classification of maternal death:[2]

1. Direct obstetric death

Defined as obstetric complication of pregnancy (labour and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above.

2. Indirect death

Referred to those resulting from previous existing disease that developed at some
point in pregnancy and aggravated by physiologic effects of pregnancy.

3. Coincidental (fortuitous) death

Death during pregnancy, childbirth and the puerperium due to external causes.

4. Unspecified maternal death

Death during pregnancy, childbirth and the puerperium where the underlying cause is unknown or was not determined

Maternal death due to cardiac problem is one of the commonest causes of death in pregnancy beside the obstetric complication during labour and puerperium.[2] Heart disorders account for about 10% of maternal obstetric deaths. In the United State, because incidence of rheumatic heart disease has markedly declined, most heart problems during pregnancy result from congenital heart disease. However, in Southeast Asia, Africa, India, the Middle East, and parts of Australia and New Zealand, rheumatic heart disease is still common. Despite dramatic improvements in survival and quality of life for patients with severe congenital heart defects and other heart disorders, pregnancy remains inadvisable for women with certain high-risk disorders such as Pulmonary hypertension,

Eisenmenger syndrome, Coarctation of the aorta if uncorrected or if accompanied by an aneurysm, Marfan syndrome with aortic root diameter of > 4.5 cm, severe symptomatic aortic stenosis, a single ventricle and impaired systolic function and prior postpartum cardiomyopathy.[3] Failed to interpret the ECG and failed to detect any cardiac abnormalities lead to this never ending problem. Little is known about the characteristic of the 12-lead ECG in pregnancy. Yet, cardiovascular disease ranks as the prime indirect cause of maternal death.[4]

As we know, in pregnancy, there is a normal physiological phenomenon causing major haemodynamic changes, including an increase in cardiac output, as well as sodium and water retention.[5] These hemodynamic changes that occur during normal pregnancy typically produce sign and symptoms that mimic cardiovascular disorder. Alterations in cardiovascular parameters during pregnancy suggest the likelihood of an altered ECG during pregnancy. So, interpretation of the normal ECG in pregnancy is an important component in the evaluation of heart disease.[4]

This technology review was conducted following a request from Director of Family Health Development, Ministry of Health (MOH) Malaysia about the effectiveness, cost effectiveness, safety and other aspect regarding on the use of ECG to screen cardiac abnormalities in pregnant women age 40 years old and above to prevent maternal mortality.

2. OBJECTIVE / AIM

The objective of this technology review was to review evidence on the effectiveness, cost-effectiveness and safety on the use of ECG to screen cardiac abnormalities in pregnant women aged 40 years old and above to prevent maternal mortality.

3. TECHNICAL FEATURES

Electrocardiography (ECG or EKG) is the recording of the electrical activity of the heart. Traditionally this is in the form of a transthoracic (across the thorax or chest) interpretation of the electrical activity of the heart over a period of time, as detected by electrodes attached to the surface of the skin and recorded or displayed by a device external to the body. The recording produced by this non invasive procedure is termed an electrocardiogram (also ECG or EKG).[6]

An ECG is used to measure the heart's electrical conduction system. It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into a waveform. The waveform is then used to measure

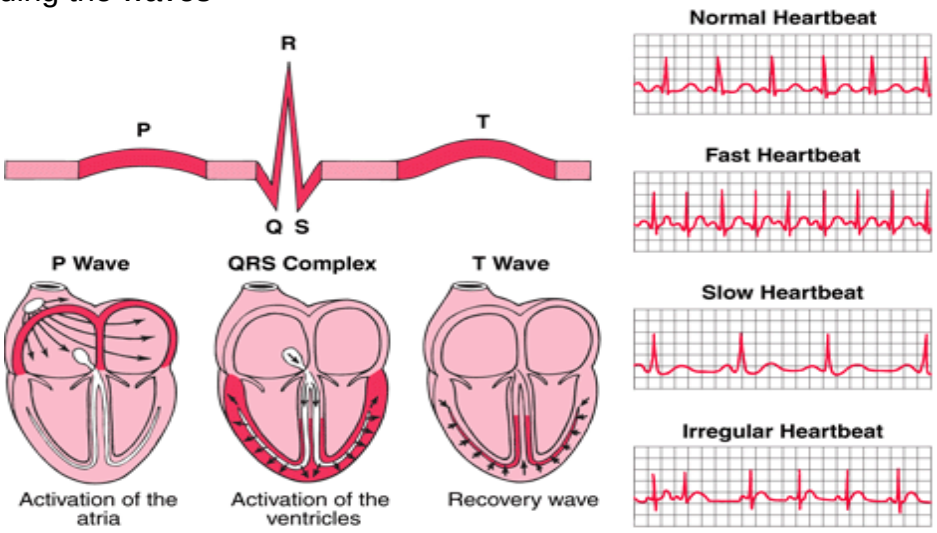
the rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart, such as a pacemaker.[6]

To obtain an ECG, an examiner places electrodes (small round sensors that stick to the skin) on the person's arms, legs, and chest. These electrodes measure the magnitude and direction of electrical currents in the heart during each heartbeat. The electrodes are connected by wires to a machine, which produces a record (tracing) for each electrode. Each tracing shows the electrical activity of the heart from different angles. The tracings constitute the ECG.[7]

An ECG represents the electrical current moving through the heart during a heartbeat. The current's movement is divided into parts, and each part is given an alphabetic designation in the ECG. Each heartbeat begins with an impulse from the heart's pacemaker (sinus or sinoatrial node). This impulse activates the upper chambers of the heart (atria). Next, the electrical current flows down to the lower chambers of the heart (ventricles). The electrical current then spreads back over the ventricles in the opposite direction.[7]

An ECG machine records these electrical signals across multiple heart beats and produces an ECG strip that is interpreted by a healthcare professional. An ECG translates the heart's electrical activity into line tracings on paper. The components of a normal ECG tracing consist of waveform components which indicate electrical events during one heart beat. These waveforms are labeled P,Q,R,S,T and U. P wave is the first short upward movement of the ECG tracing. It indicates that the atria are contracting, pumping blood into the ventricles. The P wave represents activation of the atria. The QRS complex, normally beginning with a downward deflection, Q; a larger upwards deflection, a peak (R); and then a downwards S wave. The QRS complex represents ventricular depolarization and contraction as well as activation of the ventricles. The PR interval indicates the transit time for the electrical signal to travel from the sinus node to the ventricles. T wave is normally a modest upwards waveform, representing ventricular repolarization.[8] In order to detect pathologic changes in the ECG, one has to know and recognized very well about normal ECG waves. Picture below show a normal and abnormal ECG waves.

ECG : Reading the waves



As we know, pregnancies impact a lot of physiological changes in mother especially cardiovascular. Alteration in cardiovascular parameter during pregnancy suggests the likelihood of an altered ECG during pregnancy. A good knowledge about ECG interpretation in pregnancy is one of the key players to detect the abnormalities.[4]

4. METHODS

4.1. Searching

Electronic databases searched through the Ovid interface:

- MEDLINE(R) In-process and other Non-Indexed Citations and Ovid MEDLINE(R) 1948 to present
- EBM Reviews - Cochrane Central Register of Controlled Trials(3rd Quarter 2013
- EBM Reviews – Database of Abstracts of Review of Effects (3rd Quarter 2013)
- EBM Reviews - Cochrane database of systematic reviews - 2005 to August 2013)
- EBM Reviews - Health Technology Assessment – 3rd Quarter 2013.
- EBM Reviews – NHS Economic Evaluation Database – 3rd Quarter 2013

Other databases:

- Horizon Scanning database (National Horizon Scanning Centre, Australia and New Zealand Horizon Scanning Network, National Horizon Scanning Birmingham)

- Google Scholar

General database such as Google and Yahoo were used to search for additional web-based materials and information. Additional articles retrieved from reviewing the references of retrieved articles or contacting the authors. The search was limited to articles on human. There was no language limitation in the search. Appendix 1 showed the detailed search strategies.

4.2. Selection

A reviewer screened the titles and abstracts against the inclusion and exclusion criteria and then evaluated the selected full-text articles for final article selection. The inclusion and exclusion criteria were:

Inclusion criteria

Population	Pregnant women aged more 40 years old
Interventions	Electrocardiogram
Comparators	No Electrocardiogram
Outcomes	Effectiveness, cost-effectiveness and safety
Study design	Systematic reviews, randomised control trials, cross-sectional, cohort, case control

Exclusion criteria

Study design	Case series, case report, survey, anecdotal, abstract, animal study
Type of publication	Non-English

Relevant articles were critically appraised using Critical Appraisal Skills Programme (CASP) and evidence graded according to the US/Canadian Preventive Services Task Force (Appendix 2)

5. RESULTS AND DISCUSSION

There was no retrievable scientific evidence on the effectiveness, safety and cost-effectiveness on the use of ECG to screen cardiac abnormalities in pregnant women aged 40 years old and above.

5.1. Effectiveness

There was no retrievable scientific evidence on the effectiveness of the use of ECG to screen cardiac abnormalities in pregnant women aged 40 years old and above from the electronic databases.

However there was one cross-sectional study conducted by Akinwusi et al. to describe the cardiovascular and electrocardiographic changes found among healthy pregnant Nigerian women. A total of 139 patients, comprising 69 consecutive healthy pregnant and 70 healthy non-pregnant patients at Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Osun state, south-west, Nigeria were include in this study. The study was carried out over a two-year period from February 2006 to January 2008. All the patients were taken through a comprehensive study protocol of history and physical examination by two cardiologists. A 12-lead resting ECG with a long rhythm strip of lead II was recorded in all subjects. The same cardiologists independently reported each ECG. Araoye and Sokolow-Lyon criteria were independently used to assess for left ventricular hypertrophy (LVH): Araoye criteria: R in lead I (RI) > 12 mm, or $SV_2 + RV_6 \geq 35$ mm, with or without T-wave inversion/flattening in V_5, V_6. Sokolow-Lyon criteria: $SV_1 + RV_5$ (or RV_6) ≥ 35 mm with or without T-wave inversion/flattening in V_5, V_6. Corrected QT (QTc) was calculated for each patient using Bazett's formula; a normal value in females is 0.37–0.44; > 0.44 is prolonged.

From the study, showed that, diastolic blood pressure (DBP) of less than 60 mmHg was found in 64.7% of the pregnant group, versus 24.3% of the control group (RR = 2.685, CI = 1.716–4.204, $p < 0.005$). When the patients were grouped according to age, statistical significance (for DBP < 60 mmHg) was reached for the age group 20–35 years ($p < 0.005$). Parity however did not affect DBP. Systolic blood pressure (SBP) was normal in both groups, ranging between 90 and 120 mmHg without any significant difference between the two groups.

On physical examination, findings ranging from grades 1–3 tricuspid systolic murmurs to loud P2 sounds were found in 41.2% of the pregnant group, whereas only grade 1 apical systolic murmur and occasional missed beats were found in 12.9% of the control group (RR = 3.156, CI = 1.610–6.189, $p = 0.0005$).

Expected gestational age (EGA) did not affect clinical findings ($p = 0.738$), even when EGA grouping based on trimester was used ($p = 0.391$). All patients in both groups were in sinus rhythm. Sinus arrhythmia was found only in two non-pregnant patients.

Mean ECG heart rate in the pregnant and control groups were 88.34 ± 11.46 and 75.16 ± 12.22 bpm, respectively. Sinus tachycardia was rare in both groups

(8.7% in pregnant vs 2.9% in controls). However, the increase in ECG heart rate in the pregnant group compared with the controls was significant (RR = –13.18, CI = –17.15 to –9.21, $p = 0.020$). The mean ECG heart rate and pulse rate were higher among the pregnant subjects than controls (88.34 ± 11.46; 84.03 ± 11.05 vs 75.16 ± 12.22; 75.27 ± 8.51 bpm, $p < 0.05$ respectively).

The frontal-plane QRS axis was normal in all pregnant patients and non-pregnant controls. LVH using Sokolow-Lyon criteria revealed no significant difference in prevalence between the two groups; however using Araoye's criterion in blacks (RI > 12 mm), the pregnant subjects had a higher prevalence of LVH than the normal controls (0.087, CI = 0.019–0.155, $p = 0.0189$). The LVH regressed in one of the two patients who reported for follow up eight weeks post partum; the other five patients were lost to follow up.

Non-specific intraventricular conduction defect was found in 5.8% of the pregnant group in the form of Rsr′, mostly in lead III, against 14.3% in the control group. Similarly Rsr′ was found in lead avF in 20.3% of the pregnant group, against 5.1% of the control (RR = 3.551, CI = 1.230–10.252, $p = 0.0105$).

Isolated atrial and ventricular ectopics were found in 7.3% of the pregnant group and 5.8% of the controls. First-degree atrioventricular block (PR > 0.20 s) was rare in both the pregnant and control groups (1.5 vs 2.9%, respectively). No other form of arrhythmia was found in either group.

Mild ST-segment elevation (J junction of the ST segment arising from within 1 mm of the isoelectric line, otherwise known as one of the 'normal variants' or the 'normal Negroid pattern' in blacks11) was found in 2.9% of the pregnant patients, against 24.3% in the control group (RR = 0.119, CI = 0.029–0.497, $p < 0.0005$). Isoelectric ST segment was also commoner in the pregnant subjects than the controls (97.1 vs 75.7%, RR = 1.283, CI = 1.116–0.473, $p < 0.0005$). Incidence was however less in the patients in the parity group above three (60%) when compared with 100% occurrence in the other parity groups: parity 0 and parity one to three ($p < 0.005$).

T-wave inversion in lead III ± any other lead was commoner in the pregnant group than the controls (23.2 vs 10%, RR = 2.319, CI = 1.018–5.284, $p = 0.0364$). By contrast, tall and broad T waves in V_2–V_6 occurred more commonly in the control group than the pregnant group (18.6 vs 5.8%, RR = 0.312, CI = 0.107–0.910, $p = 0.0215$).

The QTc was prolonged in a minor proportion of both the pregnant and control groups (4.3 vs 8.6%). The prolongation was however in the range of 0.46–0.47 s.

The authors concluded that, the most common findings on physical examination were low diastolic blood pressure and systolic ejection murmur. In the pregnant Nigerian woman, normal frontalplane QRS axis, normal PR interval and ST segment arising from the isoelectric line are more or less the rule. LVH based on Araoye RI > 12 mm could be seen in a few others, while all forms of arrhythmia were rare.[5, level II-3]

5.2 Safety

There was no retrievable scientific evidence from the journal database reporting on safety of the use of ECG to screen cardiac abnormalities in pregnant women aged 40 years old and above.

5.3 COST-EFFECTIVENESS

There was no retrievable scientific evidence on the cost-effectiveness on the use of ECG for screening pregnant women 40 years old and above in detection of cardiac abnormalities.

5.4 Limitation

Our review has several limitations. The selection of the studies and appraisal was done by one reviewer. Although there was no restriction in language during the search, only English full text articles were included in the report.

6. CONCLUSION

There was no retrievable scientific evidence on the safety and cost-effectiveness of ECG examination for pregnant women aged 40 years old and above in detection of any cardiac abnormalities.

There was one cross-sectional study conducted by Akinwusi et al. among healthy pregnant Nigerian women and non-pregnant women. The author reported cardiovascular and electrocardiographic changes found in these healthy pregnant Nigeria women. From the study showed that, there were some distinctive ECG features which may help to differentiate cardiac disease in pregnancy from normal cardiac findings in our practice area. However, this is considered as fair level evidence which warrants high quality clinical research.

7. REFERENCES

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3. Lara A. Friel. Heart Disorder in Pregnancy. The Merck Manual. 2013; Available at: http://www.merckmanuals.com (Assessed on 24 July 2014)

4. Goloba M, Nelson S, Macfarlane P. The Electrocardiogram in Pregnancy. 2010; 37: 693-696. Available at: www.cinc.org (Assessed on 29/5/2014)

5. Akinwusi et al. Cardiovascular and Electrocardiographic changes in Nigerians with a normal pregnancy. Cardiovascular Journal of Africa. 2011; 22(2): 71-75

6. Electrocardiography. Wikipedia The Free Encyclopedia. 2014; Available at: http://en.wikipedia.org (Assessed on 25 July 2014)

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8. ECG Interpretation. Practical Clinical Skill. 2014; Available at: http://www.practicalclinicalskills.com (Assessed on 25 July 2014)

8. APPENDIX

8.1. Appendix 1: LITERATURE SEARCH STRATEGY

Ovid MEDLINE® In-process & other Non-Indexed citations and OvidMEDLINE® 1946 to present

1	PREGNANT WOMEN/
2.	(pregnant adj1 wom#n).tw.
3.	1 or 2
4	ELECTROCARDIOGRAPHY/
5	Electrocardiogram*.tw.
6.	ecg.tw.
7.	ekg.tw.
8.	electrocardiograph*.tw.
9.	electrocardiography.tw.
10.	4 or 5 or 6 or 7 or 8 or 9
11.	3 and 10
12.	limit 11 to (english language and humans and ("young adult (19 to 24 years)" or "adult (19 to 44 years)" or "young adult and adult (19-24 and 19-44)" or "middle age (45 to 64 years)" or "middle aged (45 plus years)"))

OTHER DATABASES	
EBM Reviews – Cochrane Central Registered of Controlled Trials	Same MeSH, keywords, limits used as per MEDLINE search
EBM Reviews – Database of Abstracts of Review of Effects	
EBM Reviews – Cochrane database of systematic reviews	
EBM Reviews – Health Technology Assessment	
NHS economic evaluation database	

9.2 Appendix 2

HIERARCHY OF EVIDENCE FOR EFFECTIVENESS STUDIES

DESIGNATION OF LEVELS OF EVIDENCE

I Evidence obtained from at least one properly designed randomized controlled trial.

II-I Evidence obtained from well-designed controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.

III Opinions or respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

SOURCE: US/CANADIAN PREVENTIVE SERVICES TASK FORCE (Harris 2001)

Evidence table : Effectiveness

What is the effectiveness of using ECG as a screening method on pregnant women aged 40 years old and above for detection of cardiovascular disease to prevent maternal mortality?

Bibliographic citation	Study Type/Methods	LE	Number of Patients & Patient Characteristic	Intervention	Comparison	Length of Follow Up (If Applicable)	Outcome Measures/Effect Size	General Comments
1. PO AKINWUSI, VO OBORO, RA ADEBAYO et al. Cardiovascular and electrocardiographic changes in Nigerians with a normal pregnancy. CARDIOVASCULAR JOURNAL OF AFRICA. 2011, Vol 22(No 2):71-75.	cross-sectional, A total of 139 patients, comprising 69 consecutive healthy pregnant and 70 healthy non-pregnant patients at Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Osun state, south-west, Nigeria were include in this study. The study was carried out over a two-year period from February 2006 to January 2008. All the patients were taken through a comprehensive study protocol of history and physical examination by two cardiologists. A 12-lead resting ECG with a long rhythm strip of lead II was recorded in all subjects. The same	II-3	A total of 139 patients, comprising 69 consecutive healthy pregnant and 70 healthy non-pregnant Exclusion criteria :- previous or current hypertension, diabetes mellitus, thyrotoxicosis, history suggestive of congenital or valvular heart disease, or any other form of cardiac disease, sickle cell disease and anaemia (PCV < 30%) at the time of recruitment.	ECG			-diastolic blood pressure (DBP) of less than 60 mmHg was found in 64.7% of the pregnant group, versus 24.3% of the control group (RR = 2.685, CI = 1.716–4.204, p < 0.005). When the patients were grouped according to age, statistical significance (for DBP < 60 mmHg) was reached for the age group 20–35 years (p < 0.005). Parity however did not affect DBP. Systolic blood pressure (SBP) was normal in both groups, ranging between 90 and 120 mmHg without any significant difference between the two groups. - physical examination, findings ranging from grades 1–3 tricuspid systolic murmurs to loud P2 sounds were found in 41.2% of the pregnant group, whereas only grade 1 apical systolic murmur and occasional missed beats were found in 12.9% of the control group (RR = 3.156, CI = 1.610–6.189, p = 0.0005). -Expected gestational age (EGA) did not affect clinical findings (p = 0.738), even when EGA grouping based on trimester was used (p = 0.391). All patients in both groups were in sinus rhythm. Sinus arrhythmia was found only in two non-pregnant patients. Mean ECG heart rate in the pregnant and control groups were 88.34 ± 11.46 and 75.16 ± 12.22 bpm, respectively. -Sinus tachycardia was rare in both groups (8.7% in pregnant vs 2.9% in controls). increase in ECG heart rate in the pregnant group compared with the controls was significant (RR = –13.18, CI = –17.15 to –9.21, p = 0.020). - The mean ECG heart rate and pulse rate were higher among the pregnant subjects than controls (88.34 ± 11.46; 84.03 ± 11.05 vs 75.16 ± 12.22; 75.27 ± 8.51 bpm, p < 0.05 respectively). -the frontal-plane QRS axis was normal in all pregnant patients and non-pregnant controls. -LVH using Sokolow-Lyon criteria revealed no significant difference in prevalence between the two groups; however using Araoye's criterion in blacks (RI > 12 mm), the pregnant subjects had a higher prevalence of LVH than the normal controls (0.087, CI = 0.019–0.155, p = 0.0189). -The LVH regressed in one of the two patients who reported for follow up eight weeks post partum; the other five patients were lost to follow up. -Non-specific intraventricular conduction defect was found in 5.8% of the pregnant group in the form of Rsr′, mostly in lead III, against 14.3% in the control group.	

Bibliographic citation	Study Type/Methods	LE	Number of Patients & Patient Characteristic	Intervention	Comparison	Length of Follow Up (If Applicable)	Outcome Measures/Effect Size	General Comments
	cardiologists independently reported each ECG. Araoye and Sokolow-Lyon criteria were independently used to assess for left ventricular hypertrophy (LVH): Araoye criteria: R in lead I (RI) > 12 mm, or SV2 + RV6 ≥ 35 mm, with or without T-wave inversion/flattening in V5, V6. Sokolow-Lyon criteria: SV1 + RV5 (or RV6) ≥ 35 mm with or without T-wave inversion/flattening in V5, V6. Corrected QT (QTc) was calculated for each patient using Bazett's formula; a normal value in females is 0.37–0.44; > 0.44 is prolonged.						- Similarly Rsr′ was found in lead avF in 20.3% of the pregnant group, against 5.1% of the control (RR = 3.551, CI = 1.230–10.252, p = 0.0105). -Isolated atrial and ventricular ectopics were found in 7.3% of the pregnant group and 5.8% of the controls. -First-degree atrioventricular block (PR > 0.20 s) was rare in both the pregnant and control groups (1.5 vs 2.9%, respectively). No other form of arrhythmia was found in either group. -Mild ST-segment elevation (J junction of the ST segment arising from within 1 mm of the isoelectric line, otherwise known as one of the 'normal variants' or the 'normal Negroid pattern' in blacks11) was found in 2.9% of the pregnant patients, against 24.3% in the control group (RR = 0.119, CI = 0.029–0.497, p < 0.0005). -Isoelectric ST segment was also commoner in the pregnant subjects than the controls (97.1 vs 75.7%, RR = 1.283, CI = 1.116–0.473, p < 0.0005). Incidence was however less in the patients in the parity group above three (60%) when compared with 100% occurrence in the other parity groups: parity 0 and parity one to three (p < 0.005). -T-wave inversion in lead III ± any other lead was commoner in the pregnant group than the controls (23.2 vs 10%, RR = 2.319, CI = 1.018–5.284, p = 0.0364). By contrast, tall and broad T waves in V2–V6 occurred more commonly in the control group than the pregnant group (18.6 vs 5.8%, RR = 0.312, CI = 0.107–0.910, p = 0.0215). -The QTc was prolonged in a minor proportion of both the pregnant and control groups (4.3 vs 8.6%). The prolongation was however in the range of 0.46–0.47 s.	